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SPECIFICATION

**INVENTION:** LEG HOLDER SYSTEM FOR SIMULTANEOUS POSITIONING IN  
THE ABDUCTION AND LITHOTOMY DIMENSIONS

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# LEG HOLDER SYSTEM FOR MULTANEIOUS POSITIONING IN THE ABDUCTION AND LITHOTOMY DIMENSIONS

## FIELD OF INVENTION

This invention relates to an improved leg holder system and more particularly to such a system in which adjustment in both the lithotomy and abduction dimensions can be made simultaneously with a single action.

## BACKGROUND OF INVENTION

In recent years many newer surgical procedures have required interoperative positioning of patients legs. Until recently such positioning typically required adjusting the leg holder's mounting clamp located on the surgical table siderail, beneath the sterile drape. This raised concerns about possible violation of the sterile field and it limited the performance of such adjustments to non-sterile personnel. Recent attempts to solve this problem yielded leg holders that could be raised and lowered through the drapes, however, they have several limitations. First, when adjusted upwardly they lock by means of a ratchet mechanism; this mechanism does not prevent further unintended upward movement of the legs that could result from tilting the patient in the extreme head down direction "Trendelenburg" or from surgical staff leaning against the leg holder. Secondly, abduction is predetermined and cannot be adjusted without accessing the mounting clamp.

## SUMMARY OF INVENTION

It is therefore an object of this invention to provide an improved leg holder system.

It is a further object of this invention to provide such a system with which both the lithotomy and abductions for a leg holder can be adjusted with a single action with one hand.

It is a further object of this invention to provide such a system which permits adjustment without violating the sterile field.

It is a further object of this invention to provide such a system which prevents further inadvertent upward movement even when the patient is tilted in the extreme head down or Trendelenburg direction.

It is a further object of this invention to provide such a system which when locked prevents movement in all directions.

It is a further object of this invention to provide such a system which permits a full abduction adjustment range throughout the full lithotomy range.

It is a further object of this invention to provide such a system which the clamps are normally locked and must be activated for release.

It is a further object of this invention to provide such a system which release of the actuation of the clamps causes them to default to the locked condition.

It is a further object of this invention to provide such a system in which the clamps are remotely operable.

It is a further object of this invention to provide such a system in which the clamping operation is accomplished through the same instrumentality as the re-positioning of the leg holders.

It is a further object of this invention to provide such a system in which the leg holders are counterbalanced for reducing the load encountered by the user with a patient in place.

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It is a further object of this invention to provide such a system in which the operation of the clamping means can be accomplished with the same action as the repositioning of the leg holders or can be decoupled for independent operation.

This invention results from the realization that a truly simple, fail-safe leg holder system which enables simultaneous positioning in the abduction and lithotomy dimensions with a single action outside the sterile field can be effected using an actuator that is normally biased to clamp both the leg cradle support device and a mounting device which have a mutually transverse axes and under control of a remote operator simultaneously releases the clamping force in both devices to enable movement of the support device about both axes for repositioning in both the abduction and lithotomy dimensions.

This invention features a leg holder system for simultaneous positioning in the abduction and lithotomy dimensions. There is a support device for supporting a leg cradle and a clamping device for mounting the proximate end of the support device to a mounting device having a first axis and selectively clamping and releasing motion of the support device about the first axis and about a second axis transverse to the first axis. An actuator device actuates the clamp to selectively clamp and release simultaneously the support device and the mounting device. An operator device remote from the clamping device and actuator device operates the actuator device to enable the support device to move simultaneously about both the first and second axes in the abduction and lithotomy dimensions.

In a preferred embodiment the clamping device may include a pair of pressure blocks a first recess for receiving the mounting device and a second recess for receiving a support device. The clamping device may include a device for biasing the blocks to normally produce friction between the recesses and their respective mounting and support devices to clamp them in position. The actuator device may include an actuator rod extending with a support device. The support device may include a bore and the actuator rod may be disposed in the bore. The actuator device may include a camming device fixed to the actuator rod and a follower device disposed in the clamping device and responsive to the camming device for opposing the biasing device to simultaneously decrease the friction force on the support device and on the mounting device to release the clamping device in both axes. The operator device may include a handle for both operating the actuator device to remotely release and secure the clamping device to the support device and the mounting device and to position the support device in the abduction and lithotomy dimensions. The support device may include a resilient device for counterbalancing the weight of the leg holder. The axis of the handle may be coincident with the axis with the actuator rod for independent actuation of the clamping device and motion of the support device in the lithotomy and abduction dimensions. The handle may include a rotatable sleeve. The support device may include a leg cradle bracket for mounting a leg cradle spaced from the axis of the support means. The actuator device may include a limiter device for arresting movement of the camming device before its highest position to enable the biasing device to back-drive the camming device when the operator device is released and automatically reestablish the clamping function between the recesses and the support and mounting devices.

#### DISCLOSURE OF PREFERRED EMBODIMENT

Other objects, features and advantages will occur to those skilled in the art from the following description of a preferred embodiment and the accompanying drawings, in which:

FIG. 1 is a detailed sectional view of a leg holder system with portions broken away and foreshortened of a leg holder system according to this invention;

FIG. 2 is a view similar to FIG. 1, with the support device rotated 90°;

FIG. 3 is an exploded view of the leg holder system shown in FIGS. 1 and 2;

FIG. 4 is a pair of leg holder systems according to this invention as shown in FIGS. 1, 2 and 3 installed on an x-ray table with leg cradles and leg cradle clamps installed and employing gas cylinder lift assistance devices;

FIG. 5 is a view similar to FIG. 4 with the leg cradles repositioned with greater abduction and lesser lithotomy; and

FIG. 6 is a view similar to FIG. 4 with the leg cradles repositioned with greater lithotomy and lesser abduction.

There is shown in FIG. 1, leg holder system 10 according to this invention which enables simultaneous positioning in the abduction and lithotomy dimensions. Leg holder system 10 includes support device 12 for supporting a leg cradle not shown in FIG. 1, but seen in FIGS. 4, 5, and 6. System 10 also includes a clamping device 14, actuator device 16, and an operator device, handle 18. Support device 12 includes a hollow tube 20 which has its proximal end 22 located in clamping device 14 and its distal end 24 at handle 18. Limiter device 26 shown more completely in FIG. 3, is mounted at the distal end 24 of hollow tube 20. Clamping device 14 includes a clamp housing 30 having a recess 32 which receives and clamps a mounting device such as pivot post 34 extending from an x-ray table. Clamp housing 30 is rotatable about axis 36 of pivot post 34 which allows motion in the abduction dimension indicated by arrow 35.

Clamp housing 30 also includes a bore 38 which receives pressure blocks 40 and 42. Pressure block 40 has a bore 44 through it which receives the body 46 of pressure block 42. The enlarged tapered head 48 of pressure block 40 fits in the enlarged tapered bore 50 of clamp housing 30. Enlarged tapered head 52 of pressure block 42 fits in an enlarged tapered bore 54 of clamp housing 30. The distal end 56 of pressure block 42 includes threads 58 which mate with threads 60 on locking nut 62. The enlarged head 64 of locking nut 62 engages one of two oppositely facing Belleville washers 66 and 68 located in recess 69. Thus, when locking nut 62 is tightened down on pressure block 42 it compresses the Belleville washers 66 and 68. This causes the tapered portions 48 and 52 of pressure blocks 40 and 42 the force of the Belleville washers to be drawn tightly inwardly against the tapered surfaces 50 and 54 of clamp housing 30. This wedging effect insures a good tight clamping force which brings clamp housing together by narrowing gap 70 and thereby tightening recess 32 about pivot post 34 and simultaneously wedging pressure blocks 42 and 40 tightly in the tapered recesses 50 and 54, respectively, so that they are held against rotation in the lithotomy dimension about their central axis 72 as shown by arrow 74.

Thus, in the normal condition locking nut 62 is tightened down sufficiently to compress Belleville washers 66 and 68 so that a clamping force is applied to prevent rotation 74 about axis 72 in the lithotomy dimension and prevent rotation 35 about axis 36 in the abduction dimension. Release of both of these clamping forces in both dimensions is accomplished simultaneously by rotating handle 18 about axis 80 as indicated by arrow 82. This rotation causes actuator rod 84 to rotate along with actuator member 86 which is fixed by pin 88 to rotate with rod 84. Pressure block 42 includes a bore 75 which is larger than but coaxially

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aligned with a similar bore 76 in pressure block 40. The proximal end 22 of tube 20 of support device 12 passes through bores 75 and 76 and is fixed or force fitted in bore 76 so that when handle 18 and tube 20 of support device 12 are rotated up out of the paper as indicated by arrow 77 the entire pressure block assembly including pressure blocks 40 and 42 is rotated with tube 20.

Actuator member 16 includes two bearing portions 90 and 92 which receive needle bearings 94 and 96 that enable rod 84 to rotate smoothly within tube 20. Bearing 96 is supported in journal 98 fitted in the end of tube 20. Between bearing portions 90 and 92 is eccentric portion 100 which also supports a needle bearing 102. Riding on needle bearing 102 is follower 104 which extends through bore 106 in the proximal end 22 of tubing 20. The end 108 of follower 104 is cylindrically shaped to engage the cylindrical shape of needle bearing 102. The other end 110 is concave or cup shaped to engage the spherical tip 112 of set screw 114 which is threadably engaged in bore 116 of pressure block 42. Thus, when handle 82 is rotated about axis 80 it rotates the eccentric portion 100 to bear on follower 104 which in turn exerts an outward force on set screw 116. As a result there is a force directed along axis 72 which opposes the bias of Belleville washers 66 and 68 thereby releases the force of pressure blocks 40 and 42 on tapered portions 50 and 54 of clamp housing 30. This allows clamp housing 30 to spread somewhat thereby increasing the length of gap 70 so that recess 32 relaxes its grip on pivot post 34 and permits rotation as indicated by arrow 35 in the abduction direction and simultaneously permits pressure blocks 40 and 42 to rotate in the tapered recesses 50 and 54 so that actuator rod 84 and tube 20 of support device 12 can be rotated in a direction out of or into the paper as indicated by arrow 77.

Thus with one action, the rotation of handle 18 about axis 80, the clamp releases its grip to allow rotation about both axis 36 and axis 72 to provide simultaneous repositioning in the abduction and lithotomy dimensions. When the handle is released the force of Belleville washers 66 and 68 back-rotate the eccentric, snapping the handle to the normal position and allowing the Belleville washer to reinstate the clamping force on both axes. Covers 120 and 122 may be installed to cover the heads of pressure blocks 40 and 42, respectively.

The rotation of support device 12 in the direction of arrow 77, FIG. 1, is shown in FIG. 2, where upon the rotation of handle 18 about axis 80 and the application of eccentric 100 to counteract the clamping force of Belleville washers 66 and 68, the entire support device 12 including tube 20 and the actuator rod 84 have been rotated from the plane of the paper in FIG. 1, to the upright position where tube 20 and actuator rod 84 are perpendicular to the plane of the paper in FIG. 2.

The rotational symmetry as well as rotational action may be better understood with reference to the exploded three dimensional view in FIG. 3. Also shown in FIG. 3 is collar 130 which is held to the end of tube 20 by means of set screw 132 and the limiter collar 26a on the other end of tube 20 which is held there by means of set screws 140 and 142. A circumferential slot 144 which extends less than all the way around the circumference of limiter collar 26a receives limiter pin 146 fixed to rotate with actuator rod 84. A pair of bushings 148 and 150 are mounted on either end of limiter pin 146 after it is mounted in hole 152 of actuator rod 84 to provide for a smoother rotation within slot 144. It is limiter pin 146 in conjunction with the limited extent of slot 144 that arrests the rotation of actuator rod 84 before it reaches top dead center on the cam so that upon release by the human

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operator of handle 18 the handle and actuator rod 84 snap back to the position where they do not oppose the force of Belleville washer 66 and 68 and so the Belleville washers restate the fail-safe clamping force on both axes. Handle 18 is rotatably mounted on pin 160 which is mounted for rotation about axis 85 on pin 162. Pin 62 includes a groove 164 that allows it and handle 160 to rotate about axis 85 but which engages with spring loaded balls 166 and 168 that prevent the handle 160 and pin 162 from being withdrawn from the hollow end 170 of actuator rod 84.

Although thus far the system can be shown as actuated by mechanical device namely, the action of eccentric 100. This is not a necessary limitation of the invention, for example, any device may be substituted for eccentric 100 which will exert the opposing force on follower 104 or a similar device to release the action of Belleville washers 66 and 68 on the pressure blocks and clamp pressure blocks 40 and 42 and clamp housing 30. For example, a hydraulic piston could be installed in place of eccentric 100 driven through hydraulic lines by a foot pedal, for example, which would be remote from the device and external to the sterile drapes. Similarly an electrical device having a movable armature could be used in the same fashion or even a piezo electric crystal or similar device when only small mechanical movements are required.

Typically, in use, two such systems 10a and 10b are used in conjunction with an x-ray table 180, FIG. 4. X-ray table 180 includes two rails 182 and 184 on which slide blocks 186 can be slid into and out of the plane of the paper and tightened at a desired location by handles 190 and 192. Pivot posts 34a and 34b extend upward from clamps 186 and 188 into recesses 32a and 32b, not shown, of clamp housings 30a and 30b. Mounted on each support device 20a and 20b are leg cradles (leg holders) 200 and 202 pivotally mounted on axes 204 and 206 which are spaced from the axes 80a and 80b of tubes 20a and 20b by support shafts 208 and 210 which are supported in clamps 212 and 214 that are clamped into position on tubes 20a and 20b by handles 216 and 218. The lifting of the weight of this system including cradles 200 and 202 and the legs of the patient may be assisted by means of springs or gas cylinders or other devices as symbolically indicated by gas cylinders 220 and 222 mounted to support tubes 20a and 20b by clamps 224 and 226 and mounted to pivot posts 34a and 34b by clamps 228 and 230.

In FIG. 4, cradles 200 and 202 are in a midrange position with respect to the lithotomy and abduction dimensions. By simply gripping handles 18a and 18b and rotating them in the direction of arrows 230 and 232 the eccentric members are engaged opposing the Belleville washer force and freeing up and releasing the clamping action on both axes 32a and 32b and axes 72a and 72b. Now by simply moving the handles downwardly as indicated by arrows 240 and 242 the cradles 200 and 202, FIG. 5, can be moved to a lower position in the lithotomy dimension and may be spread farther apart in the abduction dimension as shown in FIG. 5, or alternatively the same motion of handles 18a and 18b in FIG. 4, which releases the clamp in both dimensions. After the operation of both of them which releases them in both dimensions the handles 18a and 18b can be moved upwardly to increase the position in the lithotomy dimension and reduce somewhat the position in the abduction dimension as shown in FIG. 6. In each case upon the accidental or

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